

New and Old Problems with Anesthesia Equipment

**BWH Anesthesia Grand Rounds
July 9, 2003**

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Equip Probs JHP Ready

If you stay you will learn how and why the following are true

Suction can fail 11 different ways

There are many ways a vaporizer can fail

O-rings cause many failures

New Tec7 vaporizer needs special filler adapter and must be pressed to fill

Checkout includes Ventilator

Checkout includes "Admit Patient" to reset alarms

Use an HME to keep the circuit dry and ventilator and gas sampling working

Gas Sample Filters are cracking. Save all that crack to be sent to Manufacturer

Free-hosing with Forced Hot Air (e.g., Bair Hugger) is dangerous - don't do it

Draeger Fabius moos and can have negative (sucking) leaks

A shorter checkout is possible - Should we post it? Should we do it?

ECG Filter must not be set to Maximum if want to monitor S-T, T waves

Problem Solving - Clinical vs Technical; Treat signs; Find & Treat Root Cause

Block on: Problem Solving in Anesthesia

July 9, 2003

7 - 8 AM New & Old Problems with Anesthesia Equipment

James Philip, M.D.

8 - 9 AM Hypotension

George Topulos, M.D.

New and Old Problems with Anesthesia Equipment

James H. Philip MEE MD CCE

Anesthesiologist

Medical Liaison for Partners Biomedical Engineering

Director of Technology Assessment for BWH

Biomed Intro

Failed Suction



Patient is a 29 yo F receiving general anesthesia for elective gynecologic surgery.

Immediately after loss of consciousness, the patient vomits

You place the Yankauer Suction in patient's mouth and occlude the vent hole

But, nothing happens

What is going on?

Suction can fail in many ways

DISS (Diameter Index Safety System) Connector Unscrewed at Wall



Suction can fail in many ways

DISS (Diameter Index Safety System) Connector Unscrewed at Wall
Vacuum Switched Off at DISS Connector



Canister problem

Hose disconnect from canister

Canister switched off

Insert seated incorrectly

Any port or hole open

Hose disconnect from holder

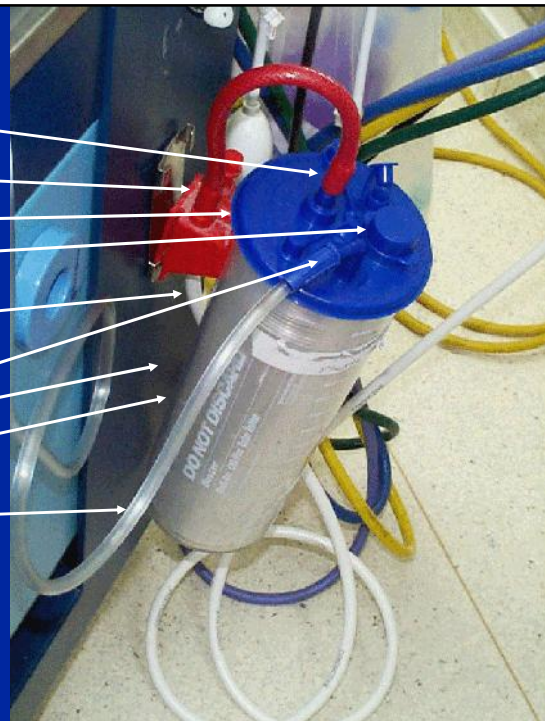
Tubing disconnect from canister

Flap valve closed

Canister Tilted

Canister Full

Hose kinked



Suction Solution



Test Function
Before Case
During Case



New Vaporizers have New Failure Modes

Tec7 Vaporizer by Datex-Ohmeda

Differences from previous

White, not black

Still Agent-specific for: Halothane, Enflurane, Isoflurane, Sevoflurane

Wider flow range = .2 L - 15 LPM

Non-spill system

limits movement of liquid if tilted or inverted

No periodic service required (Tec 4 = 1 yr, Tec 5 = 3 yr, Tec 7 no)

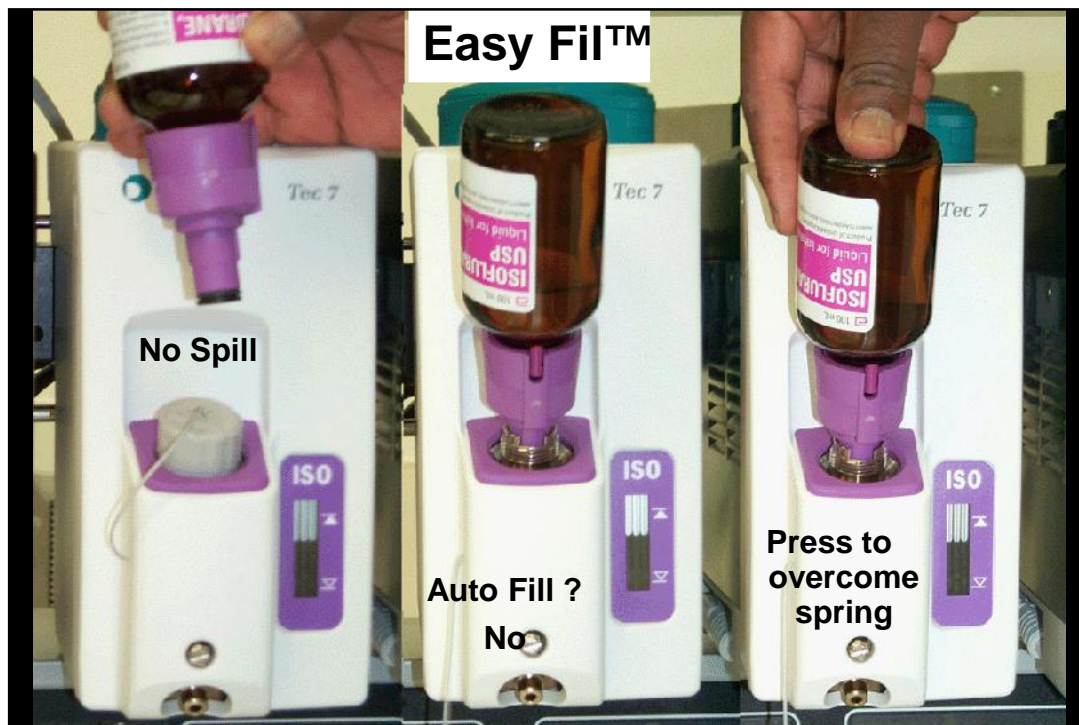
Easy-fil™ System

50% faster fill than previous (Tec 3,4,5)

Low-leak fill

Intuitive alignment (they say)

Soldered sump and seal (not O-rings)





Why no O-rings?

O-rings fail

Space Shuttle

Forreger Anesthesia Machines

O-Rings sealed a three-vaporizer turret

Failed during drug administration

Simultaneous delivery of multiple overdoses

Last product Forreger ever made

Desflurane bottle fill

**The O Ring
belongs here**



**The O-Ring
is missing**





When you change a vaporizer

When you change a vaporizer

**You are expected to do a
Negative Pressure Leak Test**

**[See FDA Pre-Use Check Card
attached to every Anesthesia
Machine]**



**Negative
Pressure
Bag your
Anes Tech
Drawer**



Condensed water vapor

Makes Ventilators fail

Makes Gas Monitors fail

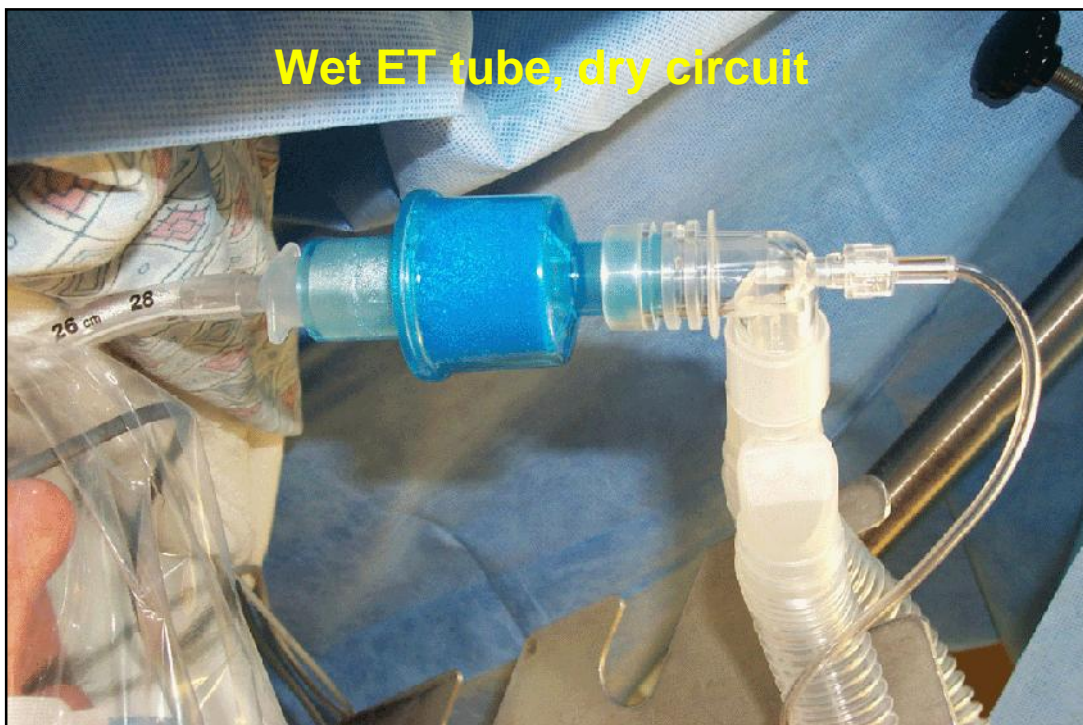
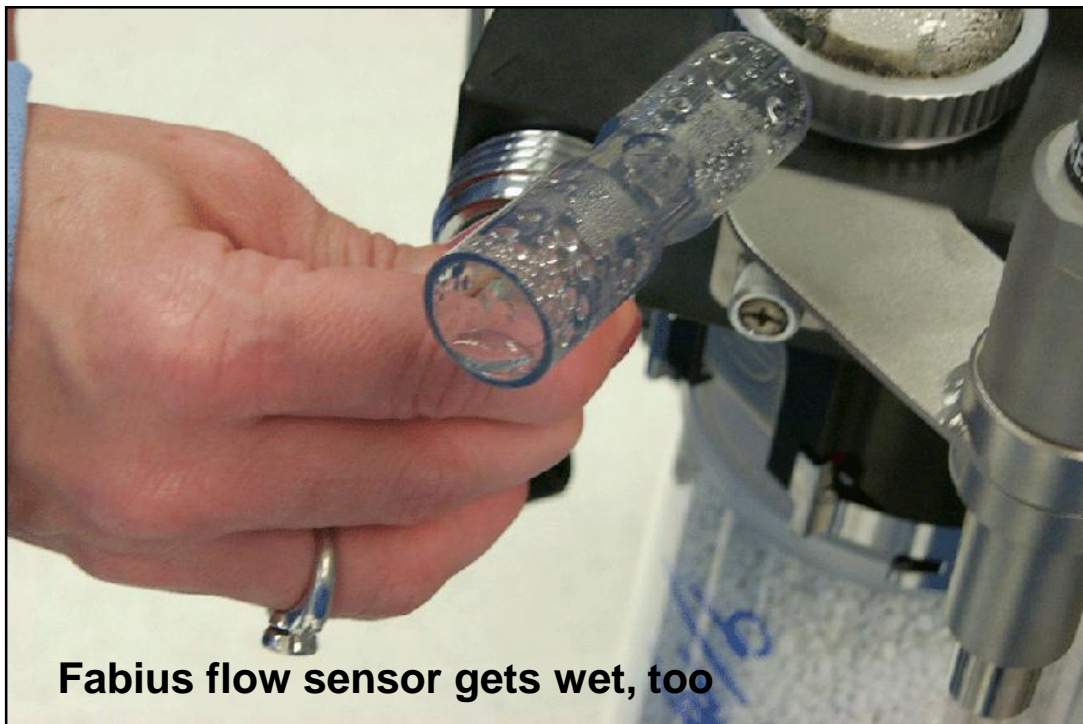
Use a Heat and Moisture Exchanger

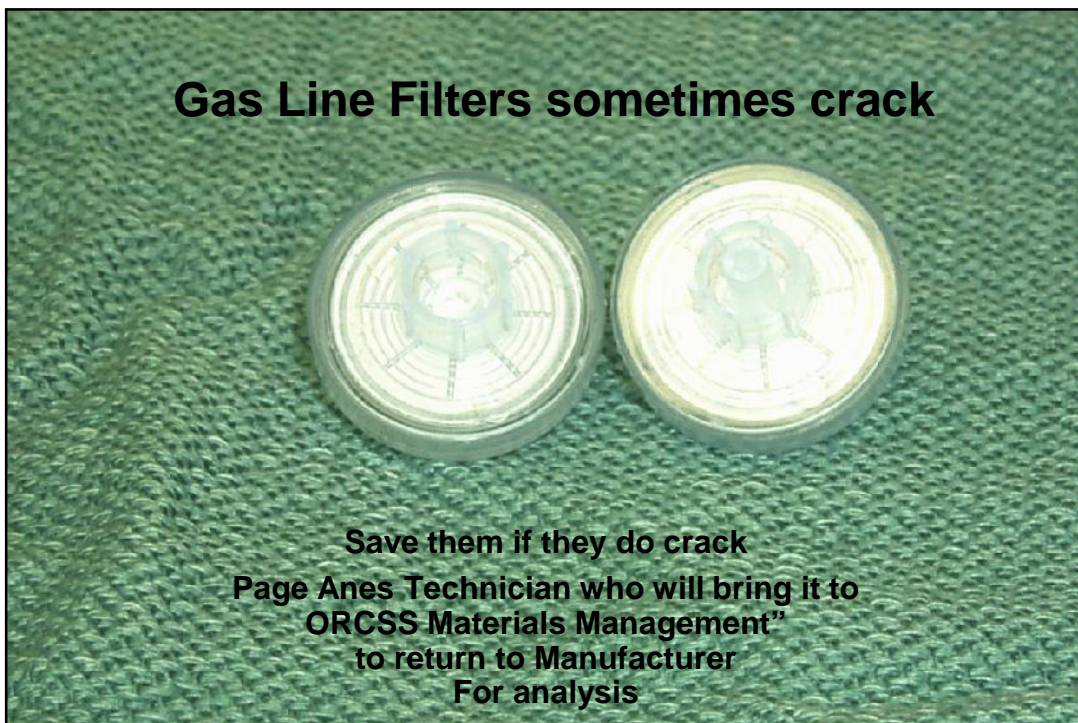
Wet dome valve - Ohmeda Mod 2



Wet dome valve - Aestiva







Forced Hot Air warming

Use a Blanket

Do not use hose without Blanket

FDA, ECRI, Manufacturers are appropriately concerned

Blanket costs around \$10.00

This is not the right place to save money

Fabius idiosynchrocies

Moos like Cow

Temporary problem which will be solved

If reservoir bag is empty or has a leak

**Air will be drawn into breathing circuit
during mechanical ventilation**

Anesthesia Machine Checkout

Important

Will pick up many problems

Common root cause of mishap is:

Failure to Pre-Check Equipment

Check Ventilator Function as part of Check Out

Ventilate reservoir bag

Observe no volume loss

Added recently to our list

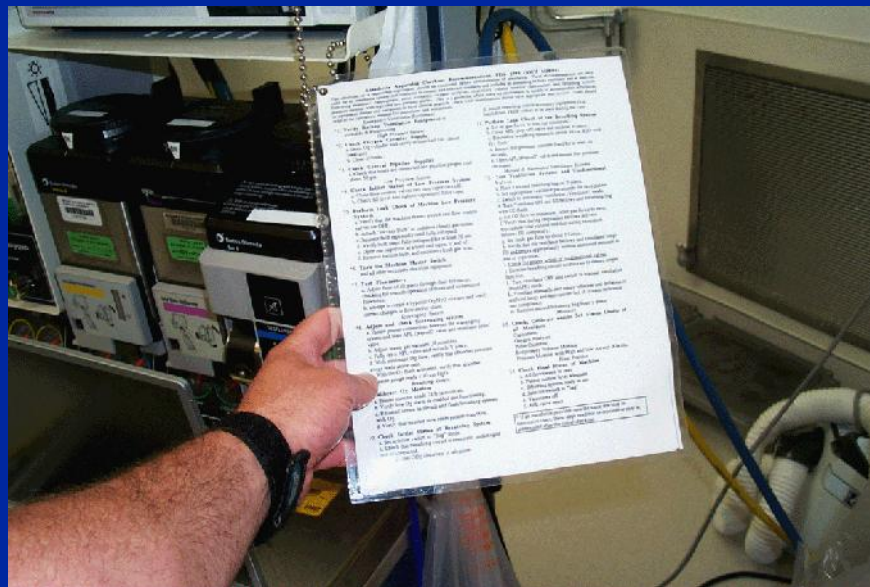
Admit “New Patient” or re-boot Monitor and Ventilator

Returns alarms and configuration
to Site-Standard Settings (BWH)

Failure to do this has led to
several reported “events”

Added recently to our list

Placard on every Anes Machine



Should we also post abbreviated checkout?

Abbreviated Machine Check Out

Calibrate **Oxygen Monitor**

Check **Machine** for gas delivery

Check **Circuit** for integrity

Check **Ventilator** for function

Check **Exhaust** for function

ECG Monitor filter must not be set to Maximum

Monitor offers several bandwidth options

All faithfully convey ST and T waves except

Maximum Filter

 This keeps wave on screen but

 Distorts S-T segment and T waves

 ST and T are “low frequency”

“Maximum” filter removes (ruins) these

Bandwidth Definitions

Diagnostic = .05 - 120 Hz

Monitoring = .05 - 40 Hz

Moderate = .05 - 25 Hz

Maximum = .5 - 25 Hz - **the only really bad one**

Troubleshooting a “Clinical” Problem

Phase 1 – Patient or Equipment Problem ?

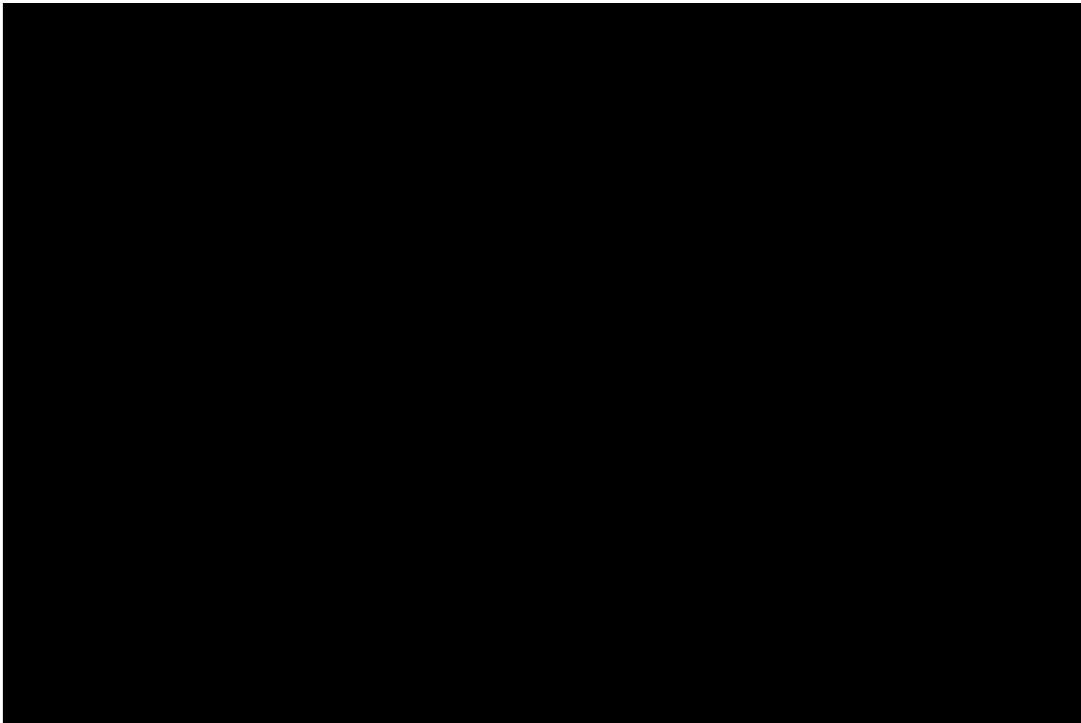
 This differentiation is crucial

 Starting on the wrong track is a bad start

Phase 2 – Treat Signs and seek Root Cause

Phase 3 – Treat or correct Root Cause

Thank you



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Requests from Anes Dept

Negative Pressure tester in each room

Techs do the negative pressure test when they change Vap

Techs do circuit pressure test when they connect circuit

Aquanaut in OR where used - likely Anes Machine Drawer

5% Sevo alarm default on RGM - Increase it if possible

End Here

New Resources - on Anes Server or CD

From Anesthesia Clinical Bioengineering Elective Residents

Brain Monitor Physiometrix PSA4000 - Maurizio Albala MD

Brain Monitor Aspect BIS - Maurizio Albala MD

GE (Marquette) 9500 Monitor - John Cabral MD

Ohmeda RGM Monitor - Jason Ryan MD

Ohmeda Tec5 Vaporizer in pieces at Sea Level & Altitude Jason Ryan MD

Aestiva Check-Out - Morana Lasic MD

Ventilators - Sascha Beutler MD

Respiratory Mechanics Module - Eveline Ehrl MD

Gas Sampling systems - Jasline Dhingra MD

End

Whom to Ask

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End